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[54] **ELECTROMEDICINAL APPARATUS FOR INTERFERENCE CURRENT THERAPY**

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[58] **Field of Search** ..... 128/419 R, 420, 421, 128/422

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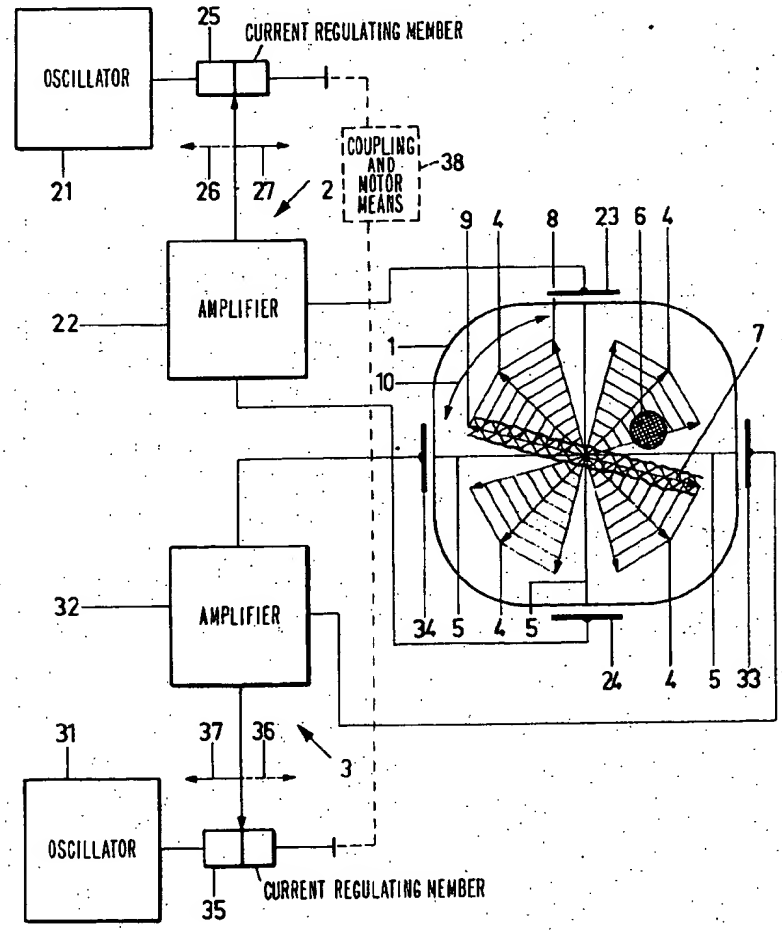
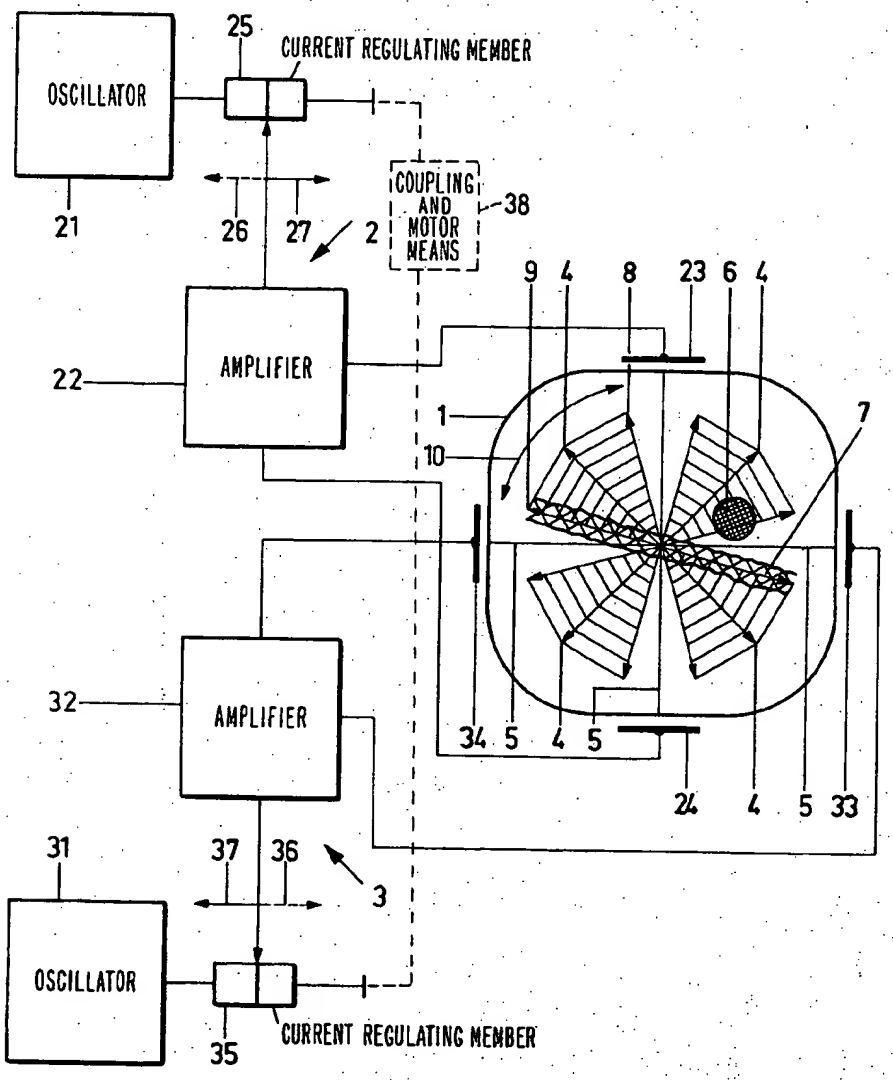
[57] **ABSTRACT**

An electromedicinal apparatus for use in interference current therapy. The apparatus has at least two circuits which act on the patient through electrodes, the circuits producing a stimulation-active interference on a target area on the patient by superimposing the two or more currents which by themselves have no stimulating effect, the currents differing from each other by a low frequency value. A particular feature of the apparatus is that the circuits produce an optimum interference at the treatment area and include a current strength regulating member which can be set in operation during treatment.

10 Claims, 1 Drawing Figure





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ELECTROMEDICINAL APPARATUS FOR INTERFERENCE CURRENT THERAPY

The invention relates to an electromedical instrument for interference current therapy with at least two circuits acting by way of electrodes on the object of the treatment, by means of which circuits an interference effective for stimulation purposes is produced at a target position on the object by superimposition of two or more currents which are in themselves ineffective alone for stimulation purposes and which differ from one another by a low-frequency value.

With this method of therapeutic treatment, the effect is utilised that, by the superimposition of at least two medium frequency currents of about 4 kc/s which are below the compatibility limit and which differ from one another by a low frequency amount of about 0 to 200 c/s, beats or interference occur in the superimposition range. These beats in the region of intersection of the current paths cause a therapeutically effective stimulation at a corresponding place on the subject of the treatment.

As is known, the most important requirement of interference current therapy is that the stimulation should be accurately localised, for example, on a member, on parts of a muscle or nerve or even on individual fibres. This means that the superimposition region of the current paths must coincide as accurately as possible with the place of treatment, in order to localise the stimulation produced by interference on this spot.

The fulfilment of this requirement depends essentially on the geometry of the electrode arrangement, to which however a limit is set as regards the free selection thereof by the object. Moreover, the object in its turn, for example, the path of a muscle or nerve fibre, is included in this calculation.

Apart from the localisation of the stimulation, naturally the intensity thereof also plays a part in the production of a best possible therapeutic effect. This intensity depends on the electrical values of the arrangement, of which the optimum has been established empirically over a period of time.

It has now been shown in practice that cases arise with which a stimulating effect is not formed, despite keeping to the empirical values and despite an arrangement of the electrodes which per se promises a successful result, and therefore a therapeutic effect is not produced.

In such cases, it has hitherto been attempted nevertheless to achieve the object by changing the position of the electrodes. Naturally, this requires a considerable number of treatments before a conclusion can be reached on the basis of the therapeutic effect as regards the efficiency of one or other of the arrangements of the electrodes. Seen from the point of view of the phsician, this is unsatisfactory, since it leads to a tedious trial and error procedure and involves unpleasantness for the patients, for example, a large number of treatments and the like. In addition, as already explained, it is not possible arbitrarily to select the electrode arrangement, since a natural limit is set for this arrangement by the shape of the surface of the body.

It is the object of the invention to provide a remedy in this respect, the said object being based on the knowledge that interference or equally strong interference does not obtain in the entire range of intersection, but that rather with constant electrical values of the instrument and a constant arrangement of the electrodes for the interference region, a vector field is to be assumed, of which the vectors indicate the percentage amount of the interference and the direction thereof. Consequently, the shape of this interference field depends on the arrangement of the electrodes.

According to the invention, for producing an optimal interference at the place of treatment in the circuits of the instrument which are independent of one another, a regulating member for the current strength and to be set in operation during the treatment is arranged in each circuit.

By variation of the current strength, it is possible to displace the interference field in such a way that optimal interference exists at the place of treatment. This optimalisation can be effected independently of the accurate position of the place of treatment and also of the electrodes. The engagement with the subject of the treatment can thus be substantially eliminated. Furthermore, not only is it guaranteed that a stimulating action is in fact obtained at the place of treatment in a location which is of difficult access, but in addition this stimulation occurs with the maximum possible intensity.

According to another feature of the invention, the regulating members of two circuits can be controlled in opposition, the regulating members or the control means advantageously being so developed that, corresponding to the alteration of the current strength in one circuit by a certain amount is an opposite change in the other circuit by advantageously double the said amount. With this opposite or reciprocal alteration, the interference intensity remains constant.

In this way, the interference intensity which has been adjusted with synchronism, for example, to compatibility, is obtained. Hence, in the current region provided by the instrument, it is of no importance that the current strength is increased in one of the circuits, since the compatibility of a medium frequency current lies considerably higher.

Finally, in a further development of the invention, provision is made for the reciprocal alteration of the two or more circuits to be effected rhythmically.

The rhythmic change, which can be obtained by suitable technical control coupling of the regulating members, results in a rhythmically changing stimulating effect at the place of treatment, which is desired in certain cases.

Other features, details and advantages of the invention will be apparent from the following description of the drawing, which shows one constructional form as a diagrammatic circuit diagram.

Indicated at 1 is a geometrically simplified object of the treatment, in the depth of which a stimulation is to become effective as a result of interference of two medium frequency currents of about 4 kc/s, which differ from one another by a low frequency amount up to 200 c/s. For this purpose, there are used in known manner two circuits 2, 3 with a current strength up to 60 mA, of which the oscillators 21 and 31, respectively, supply the required frequency. Each of these oscillators is followed by an amplifier 22 or 32, to which are connected the patient circuits comprising the electrodes 23, 24 and 33, 34, respectively.

For reasons of more easy representation, a square arrangement of the electrodes 23, 24 and 33, 34 has been chosen in the drawing, but this is not essential as re-

gards the ability to carry the invention into effect. Likewise, only two circuits 2 and 3 are shown, but these can if necessary be supplemented by other circuits. Moreover, two or more different circuits can belong to one electrode. The choice of these parameters depends essentially on the position of the point of treatment and on the surface form of the object of the treatment.

With a certain arrangement of the electrodes 23, 24 and 33, 34, for example, of the arrangement which is shown, it is possible to establish the vector field for the interference on the basis of the potential distribution which, in the slowly variable field, is approximately the same as in the electrostatic field. The object of the treatment is in this case to be considered approximately as homogeneous. Consequently, 100 percent interference is produced in the indicated direction on the vectors which are indicated at 4. With the square arrangement which has been chosen, this extends at 45° to the connecting straight lines 5 of the electrodes 23, 24 and 33, 34 associated with one another. These straight lines simultaneously represent the equipotential lines with the highest potential difference for one of the pairs of the electrodes and with the zero potential difference for the other pair of electrodes. On both sides of this vector 4, the intensity of the interference decreases and reaches the value 0 percent in the region of the equipotential lines 5.

From this, the following can be appreciated:

If the place of treatment is for example situated in the region indicated by 6, this is not reached by the maximum interference intensity, but rather the main stimulating effect is applied to some healthy regions. The same conditions are produced in respect of filamentary treatment points crossing the object 1 being treated, as indicated at 7. It is even possible to conceive of still more unfavourably disposed places of treatment, namely, those which lie immediately in the region of the equipotential lines 5.

Consequently, a regulating member 25 or 35 is connected into each circuit between the oscillator 21 or 31 and the amplifier 22 or 32. A mechanical coupling arrangement 38 of these regulating members 25, 35 is provided in such a way that, with alteration of the current strength in the circuit 2 in the direction 26, there is an opposite alteration of the current strength in the circuit 3 in the direction 36. Particularly favourable results can then be obtained if the alteration in current in one circuit by the value $2x$ has corresponding thereto an alteration in the other circuit by the value $-x$. In this case, the vector 4 travels with an intensity of 100 percent into the position 8 or 9 which is shown in the drawing. 22

By way of example, if the initial current strength in both circuits 2 and 3 amounts to $I_2 = I_3 = 20\text{mA}$, then initially the vector 4 is provided for the interference optimum. If I_2 is increased by 50 percent by means of the regulating member 25, that is to say, if it is adjusted to 30 mA, and accordingly I_3 is lowered by 25 percent, i.e., to 15 mA, the vector 4 is displaced into the position 9. In the case under consideration of the filamentary treatment point 7, the latter is consequently treated with the maximum interference of 100 percent, i.e., the therapeutic stimulation at this point is localised in optimum manner. This applies in like manner for the circular treatment point indicated at 6.

With a given treatment area, it was necessary hitherto to be satisfied by only parts thereof being acted upon with 100 percent interference. By means of the invention, the possibility is now disclosed of covering the entire treatment surface with 100 percent interference. This is effected by the fact that the current strength in the circuits 2, 3 is rhythmically changed, i.e., in the direction 26, 36 and 27, 37, respectively. The vector 4 thus moves backwards and forwards according to the double arrow 10 between the positions 8, 9, so that the maximum interference of 100 percent sweeps over a comparatively large area. Such a rhythmic change, which can be effected automatically by a setting motor controlled by limit switches which forms a part of the coupling arrangement 38, is not only advantageous in respect of treatment points of large dimensions, but is also to be considered when an increasing and decreasing stimulation is to be produced for medical reasons.

The construction according to the invention therefore not only permits an optimal interference to be achieved at the point of treatment, but in addition a stimulation can be localised extremely accurately on comparatively small and also on large treatment points, independently of their shape. In addition, a rhythmically increasing and decreasing stimulation therapy is possible.

The foregoing explanations, and also the diagrammatic drawing, are primarily applicable to a homogeneous treatment medium, but with small deviations are also valid for the human body with its non-homogenous structures. Furthermore, the invention can appropriately be transferred to electrode arrangements differing from the square arrangement and also to more than two circuits.

We claim:

1. An electromedical instrument for interference current thereby comprising at least two independent circuit means each having two electrodes for positioning on a subject to be treated, each of said circuit means providing a current of a frequency value which differs by a low frequency value from the current of another of said circuit means for application to the subject for producing an optimal stimulation active interference by superposition of the at least two currents on a target position on the subject, and current strength regulating control means for altering the current strength of at least one of the circuit means in a first direction and for altering the current strength of at least another of the circuit means in an opposite direction for shifting the optimal stimulation-active interference during treatment of the subject.

2. An instrument as defined in claim 1, wherein said current strength regulating means includes means for altering the current strength of the at least one circuit means by an amount X in the first direction and for altering the current strength of the at least another circuit means by an amount AX in the opposite direction, where A is any number.

3. An instrument as defined in claim 2, where A is 2.

4. An instrument as defined in claim 2, wherein said current strength regulating means includes means for continuously alternating the direction of alteration of current strength for the regulated circuit means such that the alteration is effected rhythmically.

5. An instrument as defined in claim 1, wherein said current strength regulating means includes means for continuously alternating the direction of alteration of

current strength for the regulated circuit means such that the alternation is effected rhythmically.

6. An instrument as defined in claim 1, wherein each circuit means includes oscillator means for providing a desired output frequency value of current, amplifier means connected to said oscillator means and said electrodes being connected to said amplifier means, said current strength regulating means being connected between the oscillator means and amplifier means of each of said circuit means.

7. An instrument as defined in claim 6, wherein said current strength regulating means includes a current strength regulating member connected between the oscillator means and amplifier means of each of said circuit means, and coupling means interconnecting said regulating members.

8. An instrument as defined in claim 7, wherein said coupling means includes motor means for continuously alternating the direction of alteration of the current strength of the regulated circuit means by the interconnected current strength regulating members.

9. An instrument as defined in claim 1 wherein said current strength regulating means includes means for simultaneous altering the current strength of the regulated circuit means in the different directions.

10. An instrument as defined in claim 9, wherein said current strength regulating means includes a current strength regulating member for each of said circuit means and coupling means for interconnecting said regulating members.

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